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ABSTRACT

The emergence of a technology-based global society is effecting tremendous changes in the economic and political world order. If our society is going to respond successfully to these changes, it must recognize the philosophic as well as strictly scientific implications of technological growth. We are entering a new era for amplifying the human powers of perception, reasoning, invention, and production. Knowledge-based systems, artificial intelligence, robotics, telecommunications, and biotechnologies are currently being developed. Such developments will soon alter the global social order. Industries and persons mastering these technologies will realize tremendous economic and political influence, with the nations having the most sophisticated technologies dominating the balance of power. If society is going to help individuals deal with the new order, fundamental changes in education are necessary. A more deterministic orientation, a more creative content, and a "systems understanding" leading to "systems thinking" will be essential components of education in the Communications Era in order to solve social problems. (LP)

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TECHNOLOGY AND YOUR FUTURE

by

Jerry L. Vaughan, Futurist

Technological advance means more to your future than whether or not to have a computer in your home. Religion, education and employment are all impacted by the pervasiveness of science and technology. We should expect more creative approaches to living in the future. If instead, we get only scientific or technological approaches, then our society is not apt to effectively respond to the emerging global information-based society with its attendant social problems.

Science and technology know no restraints or prejudices. They are deterministic in that they place everything in a scientific perspective. That is a crucial point in both historical and future contexts because it is a reductionistic or disintegrative concept. In essence, it is the purpose of the scientific method, through technology, to disintegrate or break down every system into its basic parts. The method has been successful with the profit and loss statement, the family and the atom.

The popular perception of technology is a conjured vision of exotic weapons, blinking lights, video displays, aircraft cockpits and medical devices. These popular images serve to communicate the presence of technological

SP 015 058

hardware and the function that it performs. Yet, we must grow to understand that technology is as much a philosophical application as it is the hardware that performs the function. Fundamentally, technology is any systematized knowledge based on scientific predictability.

Knowledge becomes systematized in order to accomplish perceptions of purposeful activity. Perceptions of purposeful activity are relative and may include the period at the end of this sentence within a technological definition. Certainly the syntax and punctuation of a computer program comprises the systematized knowledge of a programmer for the purposeful activity of computer software technology. Thus technology embodies application, productive skills, methods of organization, and machinery or instrumentation.

In the context of social organizations, technological advance creates new opportunities for achieving some desired goal. The success of a technological advance results in the establishment of new organizational relationtionships. In essence, technological advance disintegrates old organizational relationships. It can generally be agreed that technological developments such as the wheel, gunpowder, shipbuilding, automobiles, airplanes, mass production and the first sale of capital stock by the Dutch West Indies Company fundamentally altered social, political and economic relationships for humanity. It is fundamental for today's society to realize that technology has a far more extensive impact upon human lives than is normally acknowledged. The study of the social impacts of technology should be one of the basics of modern education. This is particularly true if this society is to have an individual or collective social conscience. If it is to learn and practice self-restraint, this society must develop and maintain a conscience.

Technology provides the rockets and instrumentation for exploration of the philosophical and scientific principles of the cosmos. In turn, this exploration generates much of the metaphorical content of the theology and social teachings of some religions of Western civilization. At the same time, technology sustains the hope for the living-dead who are plugged into life-support systems at your local hospital. Thus, the scientifically generated human application of technology creates profound philosophical, theological and moral issues that each of us will someday confront. Middle Eastern mystics and some humanist, environmentalist and fundamentalist philosophers take a dim view of Western technological capability.

A consideration of technology and your future must recognize the present status of computer capabilities and those computer capabilities anticipated in the near-term future.

The present status of computer capability is reflected at Stanford University where EXPERT computer systems now solve problems in chemistry and mathematics. The EXPERT computer systems are called DENDRAL and MACSYMA. DENDRAL is a knowledge-based system for solving certain classes of chemistry problems. MACSYMA solves algebraic equations and performs differential and integral calculus. These two systems have reached championship level in that no better means (human or machine) exists for solving general chemistry and mathematics problems.

In development are numerous knowledge-based systems that will soon reach champion status. Included in this growing list are EXPERT systems for such applications as (1) air traffic control, (2) computer systems analysis, (3) crises management and (4) computer maintenance.

While our technological society calls upon its educational system to generate greater personal ability in mathematics and science, Japan has recognized that most of the world's work is non-mathematical in nature. Japan's Institute for New Generation Computer Technology (ICOT) has determined that only a small segment of activity has as its basis the kinds of formulas that we see in engineering and physics applications. Even in such hard sciences as chemistry, most thinking is done by inference and only basic calculation. The same is true of biology, most medicine and all of law. According to the Japanese, almost all the thinking of business management is done by symbolic inference and only basic calculation. In short, Japan has acknowledged that almost all the thinking that professionals do is done by inference, not knowledge-based calculating.

Japan's acknowledgement of the role of inference in conducting occupational affairs has resulted in their $200 million National Super-Speed Computer Project. This commitment will result in computers a thousand times more powerful than any now available. Known as The Fifth Generation, the Japanese effort will result in computers that possess artificial intelligence. The Fifth Generation will obsolete computer technology as we now know it. It will revolutionize the computer revolution that we are now attempting to cope with. It is scheduled for completion in 1989. An American consortium of educational institutions and computer manufacturers based in Austin, Texas will provide just enough competitive challenge to insure that The Fifth Generation becomes a reality in the 1990's.

Virtually every occupation will be affected. Even the venerable draftsman, with his newly found computer orientation, is vulnerable as The Fifth Generation will enable the engineer to make direct graphic design entries and drawing corrections or sketches--then offer him or her suggestions for improvement.

Three other technologies will, each in its own way, soon have a revolutionary impact on the world economy (and hence your personal economy). Robotics, bioengineering and telecommunications are behind the most significant developments in our lives--the change in the economic foundation of Western life to electronically controlled and communicated work and the switch from petroleum-based chemistry to genetically-based biology.

The world community of nations is reconstituting itself through new technology. Competition is accelerating to create new industries and capture global markets. Those nations that develop the most capable social and technological policies will dominate the new balance of power that will exist in 17 years--the beginning of the 21st century. The nation with the largest number of robots, the most developed biotechnologies and the most extensive telecommunications links will almost certainly control the new global power structure. A new information-based global society and political structure is emerging.

Bioengineering is a powerful technology. It will transform the pharmaceutical, food and chemical industries into resource conservation and pollution-minimum activities. It is quite possible that bioengineering will end the energy business as we now understand it. This will be accomplished

by substituting renewable living organisms for many non-renewable feedstocks. The process industries will change. Those industries (and persons) that master this new technology will experience tremendous economic and political power. National Distillers and Chemicals Corporation is building a $100 million plant that will use a genetically-engineered yeast to make forty million gallons of ethanol annually. It will be operational by the end of 1983. Ethylene glycol, a major ingredient in antifreeze, will soon follow. Japan expects to dominate the market for bioengineered amino acids and industrial enzymes by 1989.

The high-technology frontier of microelectronic technology is redefining the old concept of the Sun Belt. What is emerging is the concept of the High-Tech Pacific Frontier. Geographically, this Pacific Frontier consists of San Francisco (the Silicon Valley), Dallas (the Silicon Plain), Austin-San Antonio (the Silicon Hills) and Phoenix (the Silicon Desert). It is the Pacific Frontier that will emerge as the population center of the United States. The exception to this geographical concentration is the Research Triangle located in North Carolina.

With the emergence of the Pacific Frontier comes a new political force with an enthusiasm for making wealth, not redistributing it. It is a political force dedicated to open markets and open social channels through which individuals can succeed or fail according to individual aptitude. With the Pacific Frontier comes an emerging sense of nationalism based on a desire to compete with Japan.

Thus, we are at another new technological threshold. A newer future looms before us. With computers, telecommunications and competition, we are entering a new era for amplifying the human powers of perception, reasoning, decision-making, inventing, creating, thinking and production. The public is ill-prepared for the problems and opportunities that the global influence of technology brings to an information-based society.

The system that we all hold in common for the future is the educational system. In considering the educational system of the future, we would be wise to recognize that computer-communications technology will spawn an economy based upon information and knowledge-oriented activities. A knowledge and information-based economy will reflect unification and integration, on a system level, of the social and technological elements that comprise the system. Hence, a "systems understanding" leading to "systems thinking" becomes a necessary ingredient in future educational processes.

It seems likely that the educational system must undergo a reconceptualization if it is to adapt to the values of an information-based society. In the first place, massive infusions of money to buy computers and attract teachers do not address the content deficiencies of the educational system in a future context.

We must recognize that the present educational system is a product of the Industrial Era. Therefore, it is system limited in terms of the Communications Era. What is taught, how it is taught, where it is taught and when it is taught are as subject to fundamental change as the change represented by the information-based society itself. It is a conceptual change that must be accomplished within the framework of a basic academic education. We

must identify the content assignment and how they will participate in its development if the future teachers are to be recruited and expected to take up the challenge. In content we need a more creative orientation in order to become both more technologically competitive and solve the resultant social problems. A more deterministic orientation in our educational practices will result in greater technological competitiveness and the inability to effectively administer a fractured and disintegrating domestic and global social structure.

A change in the educational system is a question of planning for the future--a future that goes beyond today's sacred cows and blue ribbon reformers of educational planning. It is a question of strategic planning and it is necessary because of the global influence of technology and Japanese competition.